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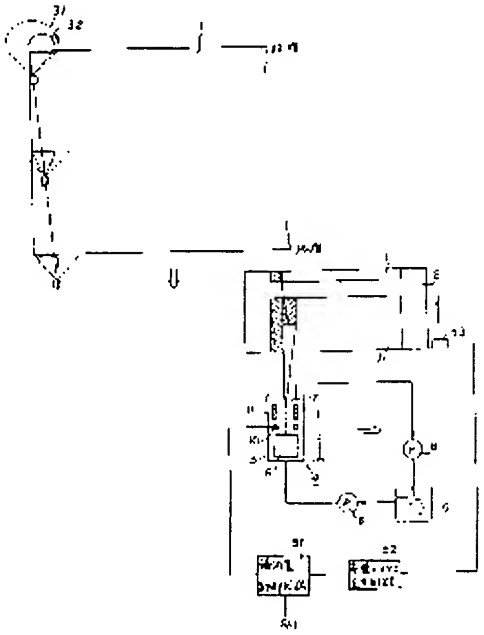
(71)Applicant : **FUJI XEROX CO LTD**
(72)Inventor : **KOIZUMI YUKIHISA**

(54) CONTROLLER FOR INKJET PRINTER

(57)Abstract:
PURPOSE: To improve the accuracy of joining outlines of images with a print width interval without incurring complication of the construction by moving a recording paper and a carriage continuously at the right angle to each other to correct the deflection of ink drops according to the preset print width and the displacement of the carriage.
CONSTITUTION: While a rotary drum 2 rotates for one cycle, a carriage 3 moves the distance corresponding to the range almost half the printable area 31. A deflection control circuit 51 charges a charge electrode 10 according to a print signal Spi using a saw tooth signal from a charge bias generation circuit 52 as bias voltage to vary the deflection of ink drips released from a drip generator 9 according to the displacement of the carriage 3 within the range of the preset print width 32. At the initial end of a recording paper 1, a printing is started with the right half of the printable area 31 as the preset print width 32 and as the area 31 for use in printing moves to the right, the angle of deflection is corrected and at the final end of the recording paper 1, the left half of the printable area 31 corresponds to the print width 32.



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(54) Title of the Invention: A controller for an ink jet printer

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(72) Inventor: Yukihisa Koizumi
Ebina Factory
Fuji Xerox, Ltd.
2274 Hongo
Ebina City
Japan

(71) Applicant: Fuji Xerox, Ltd.
3-3-5 Akasaka
Minato Ward
Tokyo
Japan

(74) Agent: Nobuyuki Matsubara, Patent Attorney (and 4 others)

SPECIFICATION

1. Title of the Invention

A controller for an ink jet printer

2. Scope of the Patent Claims

A controller for an ink jet printer, which is equipped with (a) a recording paper movement means, which moves a recording paper at a prescribed first speed, (b) a carriage that loads a deflection means that deflects a drop generator and the ink particles created by the drop generator by said drop generator, in accordance with the print signals, and that moves in a direction orthogonal to the direction of the above-mentioned recording paper at a prescribed second speed, and (c) a control part that respectively controls the movement of the recording paper according to the above-mentioned recording means, the deflection of the ink particles according to the above-

mentioned deflection means, and the movement of the above-mentioned carriage; and wherein when the print width, which has been set beforehand on the above-mentioned recording paper, and the position relationship of the above-mentioned carriage are displaced based on the movement of the above-mentioned recording paper and the above-mentioned carriage, said control part corrects the deflection of the above-mentioned deflection means in accordance with the displacement thereof and maintains the print of the above-mentioned print width.

3. Detailed Explanation of the Invention

[Technical Field]

The present invention relates to a controller for an ink jet printer, for improving for example the accuracy of the joining of images with a print width set beforehand, for example, the feed interval, on a recording paper.

[Prior Art]

Conventional ink jet printers comprise the following, as shown in the example in Figure 1: (a) a rotary drum (2) that rotates at a prescribed speed during contact printing of a recording paper (1), (b) a carriage (3) that moves in the axial direction of the rotary drum (2) only a prescribed distance each time said rotary drum (2) rotates, (c) a head (4) that is loaded on the carriage (3) and that emits towards the recording paper (1) ink drops deflected in accordance with the printing content, (d) a tank that contains the ink for printing on the recording paper (1) as ink drops, (e) a pump (6) that compression transports the ink from said tank (5) to the head (4), (f) a gutter (7) that recovers whatever ink is not used for printing out of the ink that is emitted from the head (4), and (g) a pump (8) that recycles the ink drops contained in said gutter (7) to the tank (5).

The head (4) comprises the following: (a) a drop generator (9) that generates ink drops by causing the ink that is compression transported by the pump (6) to vibrate at a prescribed granulation frequency by a piezoelectric vibrator, (b) a charge electrode (10) that charges the ink drops emitted from the drop generator in accordance with the printing contents, and (c) a deflection electrode (11) that deflects the ink drops charged by the charge electrode (10) and changes the flight path thereof.

In addition, Figure 2 shows the path of the progression of the ink drops. The drop generator (9) possesses an ink chamber (13) containing the ink (12) that is compression transported by the pump (6) and a nozzle (14) on the side part, and ink drops (ink particles) (16) are sent through the air by the nozzle (14) in accordance with the vibration of the piezoelectric element (15) provided on the side wall of the ink chamber (13). The ink drops (q16) that emerge through the nozzle (14) are charged by the charge electrode (10) in accordance with the print information, and many of the ink drops (17) not needed for printing are charged by the charge electrode (10), deflected greatly in a horizontal direction and sent to the gutter (7). On the other hand, an electric charge is provided to the ink drops when printing is to be done, and they are printed on the recording paper (1) by deflecting them in accordance with the charge.

In the above-mentioned composition, a recording paper (1) is wound around a rotary drum (2), and while it is rotated at a fixed speed ink is pressed into the drop generator (9) and the ink drops are set in flight. The ink drops in flight are charged based on the printing (print) information, the charged ink drops are caused to adhere to the recording paper (1), and the unneeded ink drops are retained in the gutter (7) and then recycled to the tank (5). The carriage (3) is initially placed in a position corresponding to the [illegible, perhaps "rear"] upper stage of the recording paper (1), and the rotary drum (2) is sent in steps by only the prescribed print width W in the axial direction of the rotary drum (2) each time the rotary drum (2) rotates once (the step send operation is carried out

when the carriage (3) reaches the position corresponding to the joint ([illegible]) of the recording paper (1)). As for the interval ([illegible]) where the recording paper is not present from the terminal point of the recording paper (1) to the starting point of the next print width W, the ink drops emitted from head (4) are collected in the gutter (7). Therefore, the accuracy of the joining of images depends on the accuracy of the position of the send steps of the carriage (3). Every time that printing of the print width W set beforehand is carried out based on the above operation, that is, every time the print of the first feed is completed, the action where by the carriage (3) moves one step (a printing amount of width W) repeats the prescribed rotation, and it is possible to carry out continuous printing of one sheet.

However, according to the ink jet printer shown in Figure 1 and Figure 2, the device is configured such that the carriage (3) is moved during the time when the joint ([illegible]) of the recording paper (1) moves, so when is carriage (3) is caused to move at a high speed corresponding to the multiplication of nozzles, along with the increase of the granulation frequency of the printing speed (for example, when one attempts to express a printing speed of 30 seconds/A4 sheet with a multi-nozzle, it is necessary to move it approximately 0.5 cm in 0.06 seconds in the event that the joint of the recording paper ([illegible]) = 3 cm), so there is a limit to the improvement of the positioning of the carriage, and thus disarray occurs in the row of ink drops emitted from the head (4) due to rapid acceleration, and there is the problem that that the accuracy of joining between the above-mentioned print widths W becomes [illegible], and a decline in image quality ensues.

In order to solve the above-mentioned problems, a proposal has been made about a device wherein as shown in Figure 3 the recording paper (1) has been wound at an inclination relative to the rotary drum (2), the carriage (3) is moved at a special speed in the direction of the arrow, and high speed printing and high quality images are obtained thereby.

[Purpose and Composition of the Invention]

The present invention was created based on the above-mentioned problems, and takes as its purpose the provision of a controller for an ink jet printer that continuously moves the recording paper and the carriage in an orthogonal direction, corrects the deflection of the ink drops in accordance with the displacement of the above-mentioned print width and carriage based on the this movement, and maintains the print with the above-mentioned print width, in order to improve the accuracy of the joining of images between the print widths that have been set beforehand on the above-mentioned recording paper without complication the constitution of the device.

[Working Example]

A detailed example is now provided of the controller for the ink jet printer according to the present invention.

Figure 4 shows the principle of the present invention. In order to improve the accuracy of the joining of the images, the device has been configured such that both the feed (the rotational speed of the rotary drum) and the scanning (the movement speed of the carriage) are respectively caused to move continuously at prescribed speeds. Concretely, the track (33) of the relative displacement of the head (4) relative to the recording paper (1), which is determined by the speed of the recording paper (1) that moves in the direction of arrow A and the speed of the head (4) that moves in the direction of arrow B, is found, and the print width (32) is set beforehand based on the said displacement track (33) and the area (31) in which deflection of the ink drops of the head (4) is possible. The ink drops are deflected and printed at this print width (32) set beforehand. In this case, the maximum deflection angle of the ink drops is corrected from (1 to (2 in accordance with the displacement of the displacement track (33), and print (34) is created in the print width (32).

Figure 5 shows one working example of the present invention. Since the same numbers of the key are use for the same elements shown in Figure 1, any overlapping explanation thereof has been omitted below. The differences in the composition are that the following have been provided: (a) a deflection control circuit (51) that determines the generation of the voltage that is impressed on the charge electrode (10) in accordance with the print [signal] (Sp1) and the timing of the impression, (b) a charge bias generation circuit (52) that emits to the deflection control circuit (51) a signal for providing as bias a sawtooth wave that performs deflection correction in accordance with the above-mentioned displacement relative to the voltage impressed on the charge electrode (10), and (c) a drum rotation position detection circuit (53) that starts up said charge bias generation circuit (52) in accordance with the rotary wave of the rotary drum (2) (may be replaced by a position detection circuit of the carriage (3)). The charge bias generation circuit (5) has been composed such that it generates a sawtooth wave signal that takes as the start-up signal the signal (generated at the starting end of the recording paper (1)) outputted from the drum rotation position detection circuit (53).

In the above composition, in order to explain the operation based on Figure 6, the recording paper (1) is set on the rotary drum (2), and when the start-up button is pressed, the emission of ink drops from the drop generator (9) begins, and moreover the rotary drum (2) begins to rotate; at the same time, the carriage (3) starts to move (speed that finishes the movement at a position corresponding to the left boundary line at the next print width when the rotary drum (2) rotates once and the starting end of the next print width emerges). For each starting end of the recording paper (1), the drum rotation position detection circuit (53) generates a detection signal as in (b), and taking the generation of this detection signal as the start-up time point the charge bias generation circuit (52) generates a sawtooth wave signal as in (c) [?; partly illegible]. The charge electrode (10) is charged in accordance with the print contents taking this signal to be the bias voltage, and as a result the deflection of the ink drops changes corresponding to the displacement of the carriage (3) within the width of the print width (32) as in (d). Consequently, irrespective of whether or not the carriage (3) has moved, printing with a print width is performed within the scope of the printing possible region (31). An explanation has been omitted of the self-explanatory portions in Figure 6.

Figure 7 [illegible] the paper wound on the rotary drum (2) in a planar state. The upper stage stands for the first rotation, and the lower stage stands for the second rotation. The carriage (3) moves through a distance corresponding to roughly half the width of the printing possible region (31) while the rotary drum (2) rotates. At the starting end of the recording paper (1), the printing is started with the right half of the printing possible region (31) as the print (32) set beforehand, and as the region used for printing (31) gradually moves to the right it corrects the deflection angle and prints within the print width (32). At the terminal end of the printing paper (1), the left half of the printing possible region (31) corresponds to the print width (32). When the terminal end of the second rotation comes to the head opposing surface, printing is again started at the left half of the printing possible region (31), and the images are joined, after which the printing of one sheet is concluded while repeating the above-described action.

Figure 8 shows another working example of the present invention, and shows the composition of a multinozzle made of four nozzles, that is, wherein the number of drop generators is four. The explanation here of Figure 8 has been simplified by omitting discussing of those items in the key that are the same as those in Figure 5. This working example has a composition wherein the following are provided: (a) a deflection control circuit (21) that generates and outputs voltage impressed on the respective charge electrodes (10) in accordance with the print signal Sp1 for each ink drop of the nozzles, (b) a paper [starting] end detector (22) that outputs a signal every time the

rotary drum (2) rotates and the starting end of the recording paper (1) reaches the nozzle opposing surface, (c) a carriage movement detector (23) that outputs by an electric signal the amount of movement of the carriage (3) that loads a multinozzle (50) equipped with four heads (41, 42, 43, 44), (d) a bias voltage generation circuit (24) that calculates the displacement of the carriage (3) relative to the recording paper (1) based on the output signal Sc of the carriage movement detector (23) and the output signal [illegible] of the paper starting end detector (22), and that outputs bias voltage that provides deflection corresponding to said displacement to the deflection control circuit (21), (e) a drum drive part (25) that causes the rotary drum (2) to rotate at a fixed speed, and (f) a carriage drive part (26) that causes the carriage (3) to move continuously at a fixed speed for each scanning range in synchronization while the rotary drum (2) rotates.

In the above composition, the carriage (3) has been set in the scanning start position (the left end of the figure), and by setting the recording paper (1) in the rotary drum (2) and pressing the start-up button, the respective pumps begin operation, and moreover the rotary drum (2) starts to rotate (ink drop generation [sic; perhaps should be "generator"] attached to the four heads and the deflection mechanism start to operate at this stage). As the rotary drum (2) rotates, the paper end detector (22) outputs a signal [illegible] at the same time as it detects the starting end of the recording paper (1). Simultaneously, when the detector (23) outputs the position signal Sc of the carriage (3), the bias voltage generation circuit (24) generates bias voltage in accordance with the amount of deflection required for printing at the print width (31) set beforehand and outputs this to the deflection control circuit (21). The deflection control circuit (21) inputs the print signal Sp1along with the bias voltage, generates a charge voltage according to this for each ink drop, and controls the heads (41-44). The ink drops supplied for printing are emitted at the width of the print width (61), and the other ink drops are recovered in the gutter (7).

A more detailed explanation of the above action is provided based on Figure 9. Two to three nozzles are deflected in accordance with the displacement relative to the recording paper (1) based on the movement of the carriage to a print width (61) set beforehand. Initially, printing is started by the heads (41, 42) for the set print width (61) that falls in the right half of the region where deflection is possible (62) of the nozzles, and as the scanning progresses, the deflection direction of heads (41) and (42) moves to the left, and moreover the heads that are operating are converted to heads (43) and (44), and then printing is performed again by heads (41) and (42) at the starting end of the second rotation and the images are joined. One image is printed by repeating the above action for each one rotation. In the figure, (63) is the maximum deflection of the respective heads. As noted above, in the event that the present invention is worked with four nozzles, it is easily possible to obtain a performance of a rotary drum speed of 2 rpm, a carriage speed of 1 cm/sec and a printing speed of 30 seconds for one sheet of A4 sized paper.

As shown in Figure 10, as far as the deflected state of the respective heads in the vicinity of the starting end position each time is concerned, immediate after printing starts the heads (41, 42) divide the printing within the maximum deflection range, head (43) begins to divide a portion thereof at position (64), and head (44) starts division at position (65), and the division of head (41) is completed at position (66). As shown in the figure, control of the printing division of the respective heads (41, 42, 43, 44) is carried out by deflection control circuit (21).

Figure 11 shows a third working example of the present invention. This is an example of the so-called round-trip carriage method whereby the heads 4' are caused to move back and forth (the deflection direction is controlled in a vertical direction) while the recording paper (1) is continuously fed. Except for the composition that moves the carriage and the fact that the deflection direction is vertical, the ink supply system and the charge control system are the same, so an

explanation thereof has been omitted here. However, the start up of the charge bias circuit (52) is performed based on the output signals of the carriage return position detectors (91, 92) that detects the return of the carriage.

In the above composition, if one provides an explanation of the action thereof based on Figure 12 (a), (b) and (c), the recording paper (1) is continuously fed upwards at a fixed speed, and the print width (81) set beforehand ends up in a region that is approximately 2/3 of the region where deflection is possible (82). That is, while 2/3 is maintained within the printing possible range (82), the direction of the flight of the ink drops of the nozzles is deflected from upwards to downwards. In this case, the feed, that is, the continuous feed speed of the recording paper (1) moves only by the distance corresponding to the width of the deflection possible region (31) in one cycle of scanning (carriage movement), and by scanning while moving the deflection possible region in the feed direction (83), it is possible to keep the printed [illegible; perhaps "region"?] within the print width (81), and it is possible to print images without any warping. Printing of one sheet is performed by executing the above operation to the end of the recording paper.

[Effects of the Invention]

As explained above, according to the controller for an ink jet printer that constitutes the present invention, the apparatus has been configured such that the recording paper and the carriage are moved continuously in an orthogonal direction, the deflection of the ink drops is corrected in accordance with the print width set beforehand on the recording paper based on this movement and the displacement of the carriage, and printing with the above-mentioned print width is maintained, so it is possible to improve the accuracy of the joining of images between the above-mentioned print widths without causing increased complexity of the composition.

4. Brief Explanation of the Figures

Figure 1 is a compositional diagram of a conventional ink jet printer. Figure 2 is a composition diagram showing the path of the progression of the ink drops in the composition of Figure 1. Figure 3 is a main composition diagram that shows another example of an ink jet printer. Figure 4 is an explanatory diagram showing the principle of the present invention. Figure 5 is a compositional diagram of one working example of the present invention. Figure 6 is a waveform diagram of the action of the each part of the working example in Figure 5. Figure 7 is a print explanation diagram of the paper joint part according to the working example in Figure 5. Figure 8 is a composition diagram of another working example of the present invention. Figure 9 is an explanatory diagram of the deflection of the bias of the working example in Figure 8. Figure 10 is a print chart showing the deflection state in the vicinity of the starting end position of head according to the working example in Figure 8. Figure 11 is a composition diagram of a third working example of the present invention. Figure 12 (a) and (b) an explanatory diagram of the deflection of the bias of the working example in Figure 11.

Key

1... Recording paper
2... Rotary drum
3... Carriage
4, 4'... Head
7... Gutter
9... Drop generator
10... Charge electrode

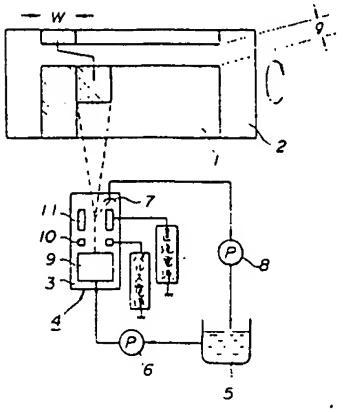
11... Deflecting electrode
14... Nozzle
21... Deflection control circuit
22... Paper feed end detector
23... Carriage movement detector
50... Multinozzle
51... Deflection controller
24, 52... Charge bias generation circuit
53... Drum rotation position detection circuit
91, 93... Carriage return position detector

Patent Applicant: Fuji Xerox, Ltd.

Agents: Nobuyuki Matsubara, Patent Attorney
Kiyoshi Muraki, Patent Attorney
Tadao Hirata, Patent Attorney
Jun'ichi Kamijima, Patent Attorney
Hitoshi Suzuki, Patent Attorney

[figures; all Japanese indications in the figures are illegible]

第1図



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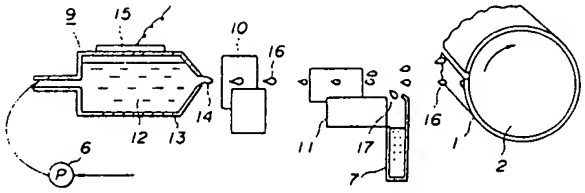

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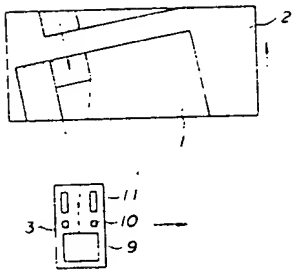

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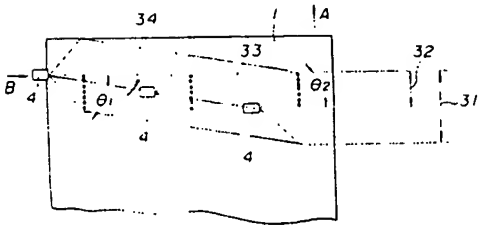

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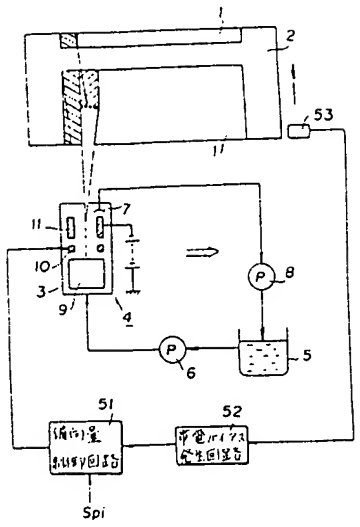

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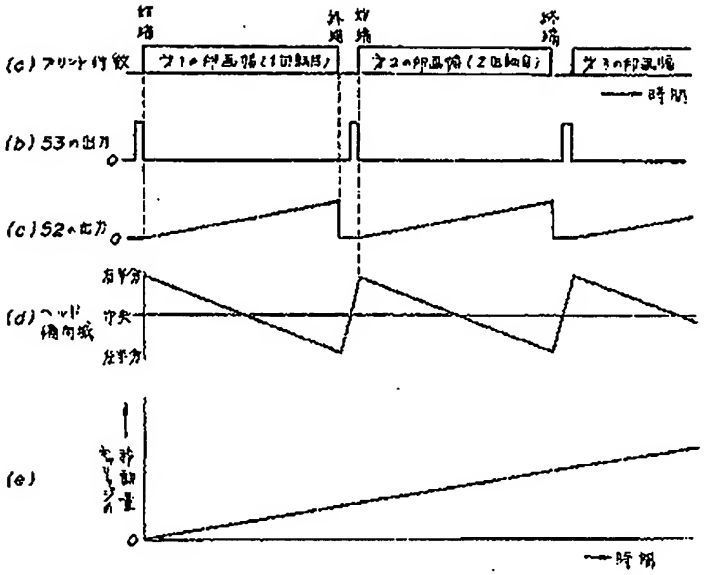
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(c) 52の出力
(d) ヘッド偏向域
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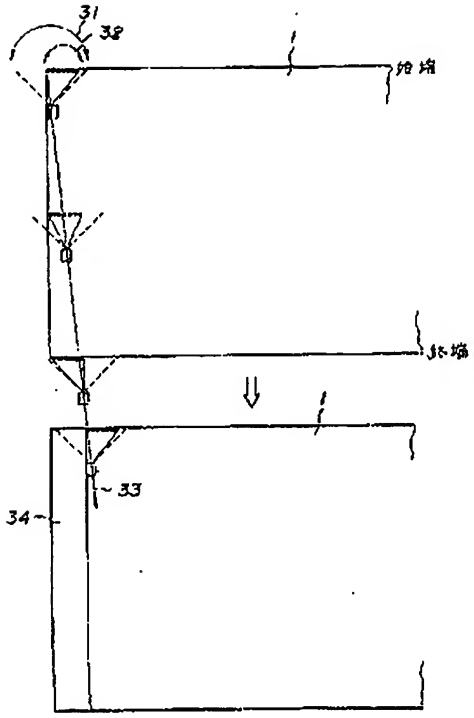
第 7 図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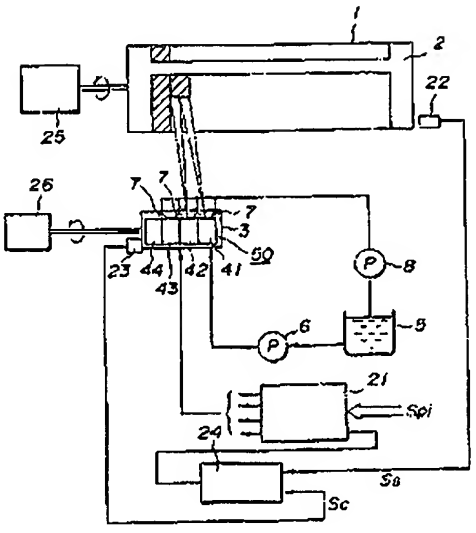
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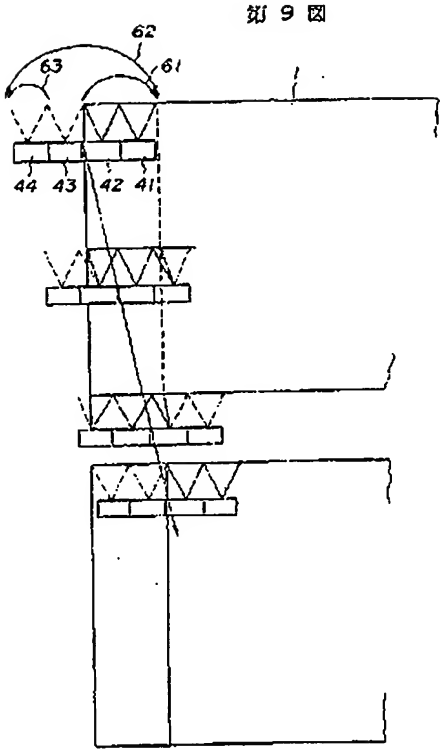
第9図



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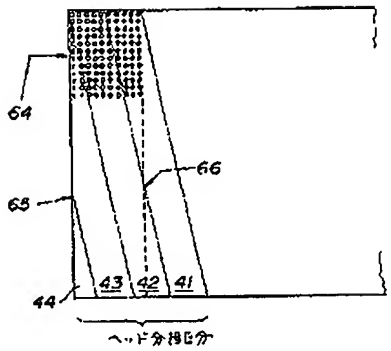

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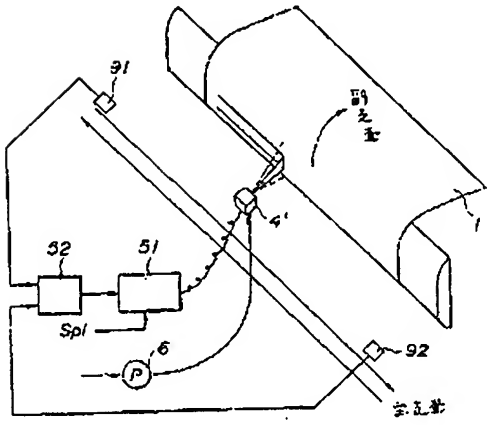

第12図